NICARAGUA

ARAP

Agriculture Reconstruction Assistance Program

Protected Cropping of Vegetables

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Submitted by:
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To:
United States Agency for International Development
Managua, Nicaragua
Under RAISE IQC Contract No. PCE-I-00-99-00003-00
Task Order No. 802
September, 2000

There are diverse problems confronting fruit and vegetable producers in areas of Nicaragua affected by Hurricane Mitch. The rainy season causes serious production problems for growers in Nicaragua as well as much of the rest of Central America, but in many instances, management may help minimize or reverse those problems.

I visited several key horticultural production areas of Nicaragua in September 2000 to:

1) Assess overall horticultural production practices and provide general recommendations for improving these practices, and

2) Evaluate opportunities for implementing selected protected cropping production technologies in promising production areas.

Specific Activities

I visited a number of horticultural operations in different geographical areas of Nicaragua with ARAP field staff. The comments that follow are my specific observations.

Sebaco Valley We visited the AGROPCSA export onion production operation with field manager Martin Flores. There are onion seedbeds for a planned 50 manzanas of export onions for Keystone Fruit Marketing. About half of the seedbeds have been planted but they are experiencing a high percentage of seedling loss in large part due to poor water and seedbed management. Some of the problem is poor bed design and poor land preparation. The beds are too wide and this is causing them to settle in the center, which retards drainage and increases humidity causing seedling loss. Beds are also planted all of the way to the edge of the bed and seedlings are lost on the bed edges due to impact of the rain and washing of the seed and small seedlings on the bed edges. There has also been some wash out of some planted beds due to poor land leveling and lack of drainage. They need to prepare beds that are no more than 1 m wide and leave 15-20 cm at each edge unplanted. Some effort should be made to determine the optimum time to remove the cheesecloth covers without aggravating the seedling losses.

We visited the Monge operation of field tomatoes heavily infected with late blight. These fields are typical of rainy season tomato fields in Nicaragua and elsewhere in Central America and show the need for protected tunnel production. The Monge operation also was producing onion seedbeds using low, flooded basins. Overall, the quality of the onion transplants was quite good. This is a more primitive system for transplant production commonly seen where water and or bedding equipment is in short supply. This system is more risky than bedded production but the seedbeds appeared well managed. These growers know what they are doing and shouldn't try to change unless they start experiencing serious losses.

We visited the MANPROSA onion operation with Romeo Murguia, farm manager and looked at newly planted onion seedbeds for export sweet onions. The MANPROSA operation has developed their production system over a number of years with diverse technical assistance and they know what they are doing. Murguia expressed his willingness to allow us to use a bedded area for a hoop tunnel field day on 9/29 and offered to help with hauling tunnels and setup. Some of Murguia's experience with onion transplant production should be implemented at AGROPCSA, particularly with bed design, preparation, and bed planting practices.

Tabasco Pepper Processing We visited the Chiles de Nicaragua / MANGOSA Tabasco pepper production fields and processing facility with Carlos Garcia, pepper production mgr, Sergio Trana, partner / manager, Claudio Martinez, Diversification mgr; Jairo Toruno, greenhouse mgr. MANGOSA is growing 60 mz of Tabasco peppers for McIlheney peppers in Louisiana. Chiles de Nicaragua is a sourcing agent for McIlheney and a partner in this operation. They grow, pick, mill and put in brine for shipment to LA. The growing operation receives $0.35 / lb for selected fresh peppers and they are now paying $0.08 to pick so $0.27 is left to the grower. They had a lot of whitefly and aphid pressure - virus was evident and spreading to newer plantings - and there were also problems with pepper weevil, mites, and white grubs. They use an intensive spray program centered on Admire insecticide. They really need to begin to rotate insecticide compounds or they will have serious resistance problems building up in the Admire. They also should consider planting all of the fields at the same time so that virus doesn't move from older to newer plantings. Depending on the area, labor availability could be a problem if they plant larger acreage at the same time.

I expressed concern about the ultimate economic viability of this type of operation. There are high investment and overhead costs evident in this operation and there is high inherent risk due to the whitefly, aphid, weevil, and mite pressure which is common much of the year. I don't know how they can avoid heavy whitefly and aphid pressure and the related virus risk. Although the pepper transplants are grown in screened greenhouses, the crop is in the field for four months after transplant before harvest and then it is harvested for three months (hopefully). This is a very long period for exposure to virus vectoring insects and the spray program is very intensive and expensive and will not be 100%`effective. So virus moves through the older plantings and then from older to younger plantings. I also suggested that they should look at trials with bedded, UN mulched peppers with well managed furrow irrigation instead of the more costly plastic mulch and drip. If virus and insects are the ultimate limitation, than perhaps they could save costs by eliminating drip and plastic mulch and yet not suffer marked yield decline.

I have misgivings about small scale, limited resource growers getting involved in a Tabasco pepper growing operation. The scale and risk should be kept quite small for the first two or three crop cycles to see in more detail how frequent and serious is the insect and virus pressure and whether growers can consistently obtain the yields necessary to make money. I also have doubts about the long-term profitability of this for even larger, better-capitalized operations. There are a lot of hidden costs in an operation like this (high volume spray

equipment, large screen houses dedicated to transplant production, harvesting containers, overhead management costs, etc.). The operation needs large volumes of pepper product and multiple seasons to pay off these costs. Whitefly, aphid, weevil, and mite pressure and the potential for virus infestation is an uncertainty that simply may not allow large volume harvest over a number of seasons.

They (MANGOSA) are doing trials with protected cropped tomatoes in the green house. I recommended additional heat tolerant table tomato varieties and altering the tomato planting pattern. They had a nice looking trial crop, which should hit a good market. MANGOSA should continue with this additional line to help pay overhead costs since the greenhouse facility is in and not 100% occupied.

UCA Cooperative - Esteli / Miraflor We visited the marketing office of the Miraflor Heroes and Martyrs Union of Agricultural Cooperatives (UCA) in Esteli and talked with Porfirio Zepeda Arana, General Manager. This is a group of growers in the Miraflor area who are converting to organic vegetable production. They sell through the UCA facility in Esteli. Arana emphasized low cost production and said that the group tries to grow with low costs of production and that the market in Nicaragua at this point is not willing to recognize organic product to the point of justifying a price premium.

I told him that all of the organic production systems of which I am aware, typically have higher costs of production than conventional systems. I suggested that low cost production may in effect be relatively inefficient and although perhaps less risky in some cases, may keep growers from realizing higher incomes. We discussed other problems producing organically in Nicaragua. Zepeda Arana is unwilling to use chlorine in wash water and I told him that all organic certifying agencies allow 4 to 10 ppm of free chlorine in wash tanks and that I was concerned about bacterial contamination of the leafy greens, etc. going into the marketplace. I told him I felt that the risk of bacterial contamination is a serious problem and may eventually limit his ability to market a clean organic product with reasonable shelf life.

We toured some of the UCA growers in Miraflor and visited fields of Carlos Castellon who grows broccoli, cabbage, and other leafy vegetables without irrigation. UCA field technician, Modesto Plato and other UCA field technicians were also present. They said that they have serious pest problems from white grubs and diamondback moth although they get some control from *Beauvaria sp*. a parasitic fungus and also with Bt sprays. The broccoli was not uniform and plant loss in the rows (white grub?) was 20 - 40%. They use a "bogache" material as their primary source of fertilizer. The material is about 25% rice hulls, 13% wood ashes, 55% chicken manure and smaller amounts of limestone, yeast, and sugar by-product. The material is “composted” for 15 days. An analysis of the material was not available.

Based on our experience with compost quality and the composting process in California, my best guess would be that the bogache would be 1% or less nitrogen, 1-2% phosphorus, and 1-2% potassium on a dry weight basis. I suspect it is 25-30% moisture. It

cannot really be completely composted in 15 days and thus; further breakdown takes place after it is incorporated. This material adds relatively small amounts of nutrients to the soil and the hauling of the bulk material (and moisture) alone is very costly. It may actually compete with the crop for soil nitrogen for the first few weeks after incorporation. I suspect the material does improve overall soil organic matter in the long term and improves soil tilth and water retention.

They apply roughly 5000 lb of the bogache material per mz. Often they apply 1/2 lb per plant (broccoli) pre transplant and 1 lb when they cultivate (aporque). The material costs 30 cordobas per 80 lb "saco". I told these growers that I felt the material was so low in nitrogen so as to seriously limit the production. And I told them that they might be better off working with the chicken manure alone. A soil analysis was not available but I also said that I suspect that phosphorus is very deficient and that these soils of volcanic origin may have very high phosphorus fixation and very high phosphorus fertility needs. They said drought is also often a problem and short-term droughts affect the crop even in a relatively rainy year. In a short visit it was not possible to determine if drought or fertility management or some other factor is most limiting their production.

There are multiple, serious horticultural problems in this area and it would take an extended period to determine what most seriously limits production and what to do about it. I suspect it varies with the crop and perhaps also with the year. This area needs a long-term applied horticultural research and extension program with one or more well trained technical field people over an extended period of time. It is an area with considerable potential for production of cool season horticultural crops including fruits, vegetables, and cut flowers. The area needs a broad based effort that would include production and marketing development and training.

Miraflor, La Concordia, San Rafael, Tomatayo, Jinotega We visited several farms in these diverse vegetable production areas. Julio Cesar Garcia produces lettuce, peppers, and tomatoes in the Tomatayo area and was particularly interested in protected cropping of tomatoes and peppers during the rainy season. Juan Pablo Orozco grows tomatoes near San Rafael. He is keenly aware of rainy season disease pressure on tomatoes and when we visited was battling a pump sprayer to spray a tomato planting to protect from foliar diseases. He would be a good candidate for field trials with tunnels.

There are a lot of small-scale onion producers in this are also but they typically harvest onions in "manojos" of doorknob-sized onions harvested with the tops. This is because of limited water for irrigation and they can't dry onions during the rainy season. We visited Valentin Ubeda who was transplanting onions near San Rafael like a large number of growers in the area. Unfortunately all of these onions will come into the market at the same time and likely after the price has fallen due to the harvest of onions in Sebaco. This area would be good for a demonstration using the plastic hoop tunnels to dry onions in the rainy season.

There is usually a lot of rain fed lettuce production throughout this area. All of the growers were planting and harvesting at the same time and accept losses of 30-40% because it is all rain fed and they don't have another chance to grow. The crop appeared to be all iceberg lettuce and conversations confirmed that. Trials with diverse types of leafy lettuces, romaine, etc. would be valuable in this area. Like Miraflor, this area seriously needs a long-term horticultural production and marketing research and extension effort.

La Trinidad - Consejo de Excombatientes de Guerra (COEG) We visited the COEG with Magdiel Torres, the resident field extension agent. This is another area devoted to onions, tomatoes, peppers, watermelons. We found a large number of small-scale growers all producing the same crops at the same time . The growers in this area are aggressively applying the improved practices available to them. There are several ONGs working in the area. They are building water storage tanks (pilas) and also demonstrating use of simple, appropriate technology drip irrigation systems. We visited several farms in the La Canada / Licoya area (Juan MIranda, Johnny Torres, Santiago Torres) planting onions and harvesting watermelons and we saw recently transplanted tomatoes. Growers in the area were interested in the Tabasco pepper production possibility. They have high whitely pressure in the area and I suspect other diseases of peppers also. The most profitable currently grown crops are onions, tomatoes cabbage, peppers (chilote). Growers in this area would be good candidates for a protected cropping tunnel project and / or a project which helps diversify their crop mix some such as sweet corn.

Santa Rosa Cooperative - Somoto We visited the coop and the farms of Arturo Martinez Rivera, Modesto Huate, and Antonio Rivera. This is a relatively new producers cooperative. They need and want help with marketing and market information and improved horticultural practices. They also could use help with post harvest cooling and storage. They have just been introduced to the use of low volume drip irrigation systems and some are putting in new water storage tanks. They are diversifying some (avocados) and they are moving from planting onions in sunken basins to raised beds. I discussed some of the critical aspects of the management of onions in the different systems. They were interested in the use of tunnels to dry onions and beans and also to grow tomatoes. These three growers later attended the field day on hoop tunnels in Sebaco. This is another area with great potential but they need a long-term horticultural production and marketing program in this area also.

Hoop Tunnel Design and Management

Tomatoes, peppers, squash, lettuce, and other crops are adversely affected by the frequent rainfall and high humidity during the rainy season. Foliar diseases increase dramatically during the rainy season and overall yield and quality decrease. The marked and widespread shortfall in production creates market shortages and prices are often much higher for many crops during much of the rainy season and early dry season. Additionally, fresh market-type

table tomatoes which are often more desirable and more costly in the market are substituted during the rainy season by industrial type processing tomatoes which are more disease resistant.

Protected cropping (PC) is used widely around the world to modify the environment in diverse situations and enable the production of a wide array of fruits, vegetables, and ornamentals. Protected cropping often involves the use of some type of greenhouse or screen house-type structure to modify the growing environment. Many of these types of systems are primarily used to control temperature although other types of environmental modification are possible. Some of these plastic covered structures may be modified and incorporated into a system that essentially seeks to control moisture and thereby retard or delay disease development.

I worked with ARAP field personnel to build some demonstration hoop tunnels (HT) using designs appropriate for the tropics, which I have modified over several years. We identified metal shops capable of fabricating the HT structures and we used the tunnels to establish field demonstration plots in the Sebaco Valley. I also presented a talk on protected cropping and the use of the HT for rainy season production and post harvest management in Nicaragua. The talk was followed by a field exercise to demonstrate the HT system to interested growers.

Structures There are diverse designs of PC structures, which are in use in different areas with the intention of extended production of fruits or vegetables. Often the differences in the structures are dramatic and may range from large, sophisticated plastic covered greenhouses - with or without automatic temperature control - to much simpler structures made of polyethylene plastic sheeting covering a wood or bamboo structure. Costs can vary dramatically also and in many instances, the size of the potential market and the anticipated market price do not justify the investment and management costs of the structure. Smaller, simpler, and less costly structures are needed for small-scale growers. But these structures should be designed and constructed to solve the potential problem of rainy season production - excess moisture on the plant and soil - and still be affordable and manageable on a small scale.

A modified HT design can be used to cover a growing crop of tomatoes or bell peppers or also transplants and primarily serves to keep the plants and soil relatively dry during the rainy season. In some instances, the same structure may also be used to dry onions or dry beans during the rainy season or to sun-dry tomatoes or other fruits. The real challenge with these structures is not only to keep the plant dry but also to keep the plant and soil covered without excessive heat gain during sunny or partly sunny periods. Any structure that at all restricts ventilation can cause passive heat gain and the covered plastic area actually can become a solar collector capable of desiccating a crop in a brief period of inadequate ventilation.

The following is a description of key components of a HT system for rainy season production and post harvest management in Nicaragua.

The main HT structure is a tunnel skeleton made from galvanized pipe. The pipe typically comes in 20 ft (6 m) lengths. One-inch diameter pipe is formed into arches 3 m wide and 2 m high. These arches are connected by 10 ft (3 m) feet pieces that are attached to the arches at the base on each side. One-half inch diameter pipe is used to connect the arches in the center at the top. Welded couplings with set bolts are used to tightly attach these connecting sections. And the structure is covered with clear polyethylene plastic approximately 20 ft (5 m) wide. The individual sections composed of the two arches can be assembled in tunnel lengths up to 100 ft (3 m). The structure is then covered with clear polyethylene plastic that runs lengthwise down the tunnel. Lengths of plastic twine (cabuya) run between the arches every foot (30 cm) provide additional support beneath the plastic. The plastic is tightly stretched over the structure and anchored to buried posts at each end. Additional lengths of twine are run cross-wise over the top of the plastic and secured at the foot pipe pieces with two lengths of twine at each arch. An additional length of twine can be run over the top of the tunnel at each arch to secure the plastic at the desired height by tying the twine to the arch.

The HT can be slowly built in sections composed of two arches connected by the ten-foot long base and top pieces. Experience indicates that the galvanized pipe structure will last at least 20 years and polyethylene plastic typically lasts one to three years depending upon the quality of the plastic and handling. Not all plastic materials are currently available in Nicaragua in appropriate widths. Some of these materials are reportedly available in Guatemala.

The sides of the plastic cover are raised and lowered to ventilate the tunnel during clear sunny weather or to protect the soil surface and plant leaf surface during rainy weather. Managing the raising and lowering of the tunnel sides is especially critical to the success of the system. The tunnel most ventilate well at the first sign of clear skies or sunshine because the potential exists for excessive heat gain and retention in the tunnel. It is also important to protect the plants and soil surface from rains as completely as possible to avoid or retard disease development. The plastic sheeting is extended to the ground and covered with loose soil in those cases where the structure is used to dry onions or beans. Onion may be dried in piles of in standing ventilated onion bags.

Smaller tunnels that cover only one bed may be used for strawberries and protected seedbeds. These tunnels typically use No. 8 galvanized wire bent into hoops, ft (1.5 m) long (or varying depending upon bed width). One-quarter inch thick reinforcing construction wire may also be used but it oxidizes and is more difficult to manage. Hoop wires are pushed into the soil 8 - 12 inches (20-30 cm) on each side. One meter wide plastic sheeting is stretched tightly over the hoops and tied to posts at the ends of rows. A second hoop is placed over the first hoop to hold the plastic tight. For protected seedbeds, where it may not be important to keep the beds dry but rather protect from the force of driving rains, cheesecloth is often substituted for clear polyethylene plastic.

Land Preparation. The preparation of raised beds can add substantial benefit to the HT system. Drainage is improved and disease pressure reduced by the use of raised beds. Raised

beds require careful irrigation management but overall are a positive addition to a tunnel system. Additional outside drainage canals should also be designed to avoid water running into the tunnel during periods of intense rainfall.

Two raised beds approximately one meter wide are an appropriate way to start the high tunnel production system. A number of crops could be adapted to this bed system but further agronomic trials should be conducted to refine specific plant spacing arrangements for optimum production of specific crops in specific environments.

Agronomy. Traditional agronomic practices for specific crops in specific areas should be used as the starting point for tunnel production. Traditional soil fertilization and irrigation practices will work in the tunnels and additional trials can be established to refine agronomic practices such as varieties, fertilization rates and timing. Pest control and pest pressure will likely vary considerably within the tunnels but specific practices will be necessary with specific crops in specific areas. Field practices serve as guidelines for insect and disease control programs. Additional trials should be established to investigate the feasibility of incorporating fine mesh insect fabric to deter insect pressure from flying insects such as whitefly and aphids.

A special mention should be made of whitefly and aphid pressure. The tunnel system is really designed to allow production of crop during the rainy season to access more profitable rainy season markets. It is common in Nicaragua and elsewhere in Central America that the whitefly and aphid pressure decline dramatically during the rainy season. Thus, the tunnel system can be used when whitefly and aphid pressure is low and the tunnels are eliminated and harvests are winding down as insect pressure rises during the dry season.

Irrigation. Drip irrigation improves the control of humidity and free moisture within the tunnels although furrow or sprinkler irrigation may be used effectively. It is important to manage water to minimize the humidity in the crop microclimate and to allow the soil surface to dry sufficiently between waterings. If drip irrigation is used, the plants should be drenched or sprinkled in the initial 1-2 irrigations following transplanting, before converting to the drip tape. If furrow irrigation is used, care should be taken with the design of furrows to minimize the velocity of water movement and control uniform wetting within the beds.

Wind Protection. Tunnels should be established in an area protected from the wind wherever possible to minimize potential wind damage to the tunnels. The establishment of windbreaks in the tunnel production area may be an option in those cases where the tunnel will be used in the same area season after season. The plastic cord stretched between arches underneath the plastic and cord wrapped over the top of the plastic will further protect from wind damage. The plastic stretches with initial exposure to heat and will need to be tightened during the initial few days. It is important to take care to always keep the plastic tight to protect from excessive movement in the wind and to not allow pockets to form where water will collect during the rain. Pockets in the plastic that fill with water may break and damage plants inside.

General Recommendations.

There is widespread interest in using protected cropping with hoop tunnels to improve rainy season production of diverse vegetable crops in distinct areas of Nicaragua. There is also interest in using the hoop tunnels for drying onions and beans during the rainy season. There are some additional specific opportunities to diversify fruit and vegetable production and improve farm income in key horticultural production areas of Nicaragua.

These are specific recommendations for pilot production and marketing demonstration and training projects to be undertaken during 2000 / 2001.

1.) Arrange for the fabrication of 20 - 25 hoop tunnel demonstration modules for placement on strategic sites in several different growing areas. Concentrate on rainy season production of tomatoes and bell peppers for the October to January market window. And also use the tunnels to demonstrate drying of onions and dry beans during rainy weather. Establish one or more tunnels in each of the following geographic areas:

- Sebaco Valley
- La Trinidad
- La Canada
- Somoto
- Pueblo Nuevo
- La Concordia
- San Rafael
- Tomatayo
- Jinotega

2.) Establish a sweet corn production and marketing pilot project in one or two promising growing areas. Concentrate on high quality prepackaged sweet corn for Managua. I suggest trying the areas of Somoto and / or La Trinidad. Use varieties and production practices similar to those successfully being used by the Honduran Agricultural Research Foundation (FHIA) in the Comayagua Valley of Honduras.

3.) Establish an organic leaf lettuce production and marketing pilot project in the Miraflor area. Concentrate on high quality, prewashed leafy lettuce types for upscale restaurants and grocery stores in Managua.

Each of these projects have multiple production and marketing related components and all will serve as valuable multi-phase instructional and demonstration exercises for participants

and other growers in the geographic areas. These projects can be readily implemented with existing technology and aimed at ready domestic markets.